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ABSTRACT

Developed by the ABCs of Construction National Workplace Literacy Project, these curriculum materials for the occupational area of pipefitting contain a lesson that deals with reading diagrams. The lesson consists of an objective, instruction, and 10 exercises. Three types of problems are provided in each exercise: "try it," "apply it," and "go with it." The objective for the lesson is for the student to learn to locate and apply information from a diagram. (YLB)

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TECHNICAL DEVELOPMENT CENTER
ED 374 307

# *Reading* Diagrams

## PIPEFITTER

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Associated Builders & Contractors, Inc.
EBR Adult & Continuing Education

## ABC's of Construction
### *National Demonstration Project in Workforce Literacy*

The ABC's of Construction Project was funded in 1991 by the U.S. Department of Education as a grantee through the National Workplace Literacy Program (PR #198A10155). The program provided basic skills instruction to industrial construction workers employed by companies which are members of the Pelican Chapter of Associated Builders and Contractors (ABC). Located in Baton Rouge, Louisiana, ABC provides training to employees of over 60 member companies who perform contract work in the 58 petrochemical facilities located along the Mississippi River between Baton Rouge and New Orleans.

The grantee, the Adult Education Department of East Baton Rouge School Board, performed a comprehensive literacy task analysis of the apprenticeship training program for millwrights, pipefitters, electricians, instrumentation techs, and welders involved in the ABC training program. Over 20 modules of original, contextual curriculum were developed to teach the reading and math skills required for success in the craft training program.

Materials developed for instruction incorporated cognitive strategies for learning basic skills in the context of the craft and safety knowledge demanded by the industrial construction workplace. Instruction was written for a competency-based, open-entry/open-exit, individualized adult learning program that operated at the ABC training center in the evenings after work-hours.

**OBJECTIVE**

**You will learn to locate and apply information from a diagram.**

**INSTRUCTION**

The workers clocked in. They began to plan the day. They walked to the jobsite. They remembered that they needed to put in a gate valve and a 90 degree ell. Should the ell be turned up or down? The piping system was so complex. They couldn't remember what to do.

They walked back. They got some coffee. Then, they took out a flanged fitting joint drawing. The drawing gave them an overview. It showed the whole system. The drawing's symbols and line numbers gave them the details they needed. They found the answer. They went back to work.

Flanged fitting joint drawings are kinds of diagrams. Diagrams show complex ideas. You use diagrams on the job. You also find them in pipefitting coursework. Diagrams have many uses. They can show a reduced version of something large. They can show an enlarged version of something very small. They help you picture processes, structures, relationships, or details. In all cases, diagrams help you visualize.

All diagrams have a main idea or purpose. The diagram's title helps you find the main idea. Diagrams also have details. Labels show you which details need your attention. To use a diagram, you decide how the details fit with each other and with the main idea.

Text descriptions often accompany diagrams. Such descriptions serve varied functions. They can identify the main idea. They can list details. Text descriptions can also tell you things which you might not be able to see from the picture. They can tell you how something works. They highlight specific features. They can describe processes and relationships. You should look back at the diagram as you read the description. Because diagrams show complex ideas, you may find them hard to understand after one reading. Reread both the diagram and the text until you understand them.

## STEPS IN READING DIAGRAMS

1. **READ THE TITLE.** The title tells you which process, relationship, or item is being shown.

2. **EXAMINE ANY LABELS.** Labels help you focus on important features.

3. **WHAT IS THE PURPOSE OF THE DIAGRAM?** What is it about the item or process which requires you to picture it?

4. **WHAT TEXT INFORMATION ACCOMPANIES THE DIAGRAM?** What additional information describes the diagram? How is it described? What details are included? Why are those details included? How do the text and the diagram relate to each other?

5. **WHAT IS THE MAIN IDEA?** How can you describe the diagram? What's important about it? How does knowing this apply to your work?

## DOUBLE LINE DRAWINGS

**EXAMPLE**

A double line drawing is a clear picture of the piping system. It is the easiest drawing to understand. However, this type of drawing requires a great deal of time to draw and is not often used. Figure 10.1 shows two views of a double line drawing. The elevation drawing shows the front view of the system. The plan drawing shows the top view.

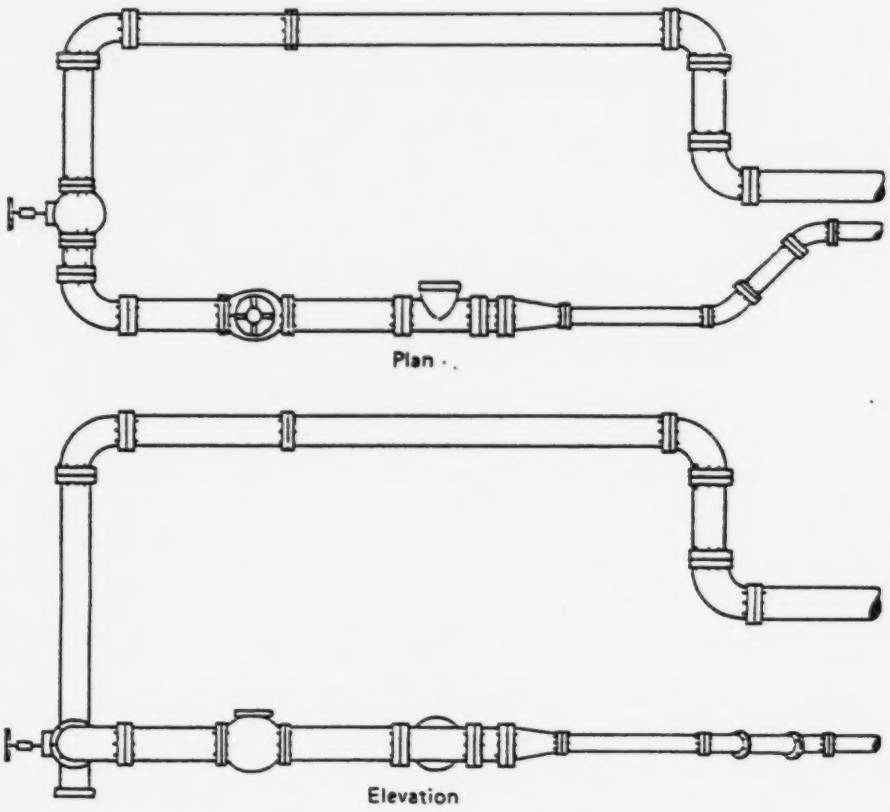


Figure 10-1 Double Line Drawings

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1. **READ THE TITLE.** The title is "Double Line Drawings."

2. **EXAMINE ANY LABELS.** The top drawing is labeled "plan." The lower drawing is labeled "elevation."

3 **WHAT IS THE PURPOSE OF THE DIAGRAM?** The diagram com pares two views of a double line drawing.

4. **WHAT TEXT INFORMATION ACCOMPANIES THE DIAGRAM?** A short paragraph defines double line drawing. It describes the limitations of using such drawings. It refers to the figure which shows two kinds of double line drawings.

5. **WHAT IS THE MAIN IDEA?** The main idea is that double line drawings provide a clear picture of a piping system, but may take too much time to draw.

Diagrams have purposes. However, your use for them varies according to your purpose. For example, in using the preceding diagram, you might be interested in the elevation view. You would focus on the following parts of the diagram:

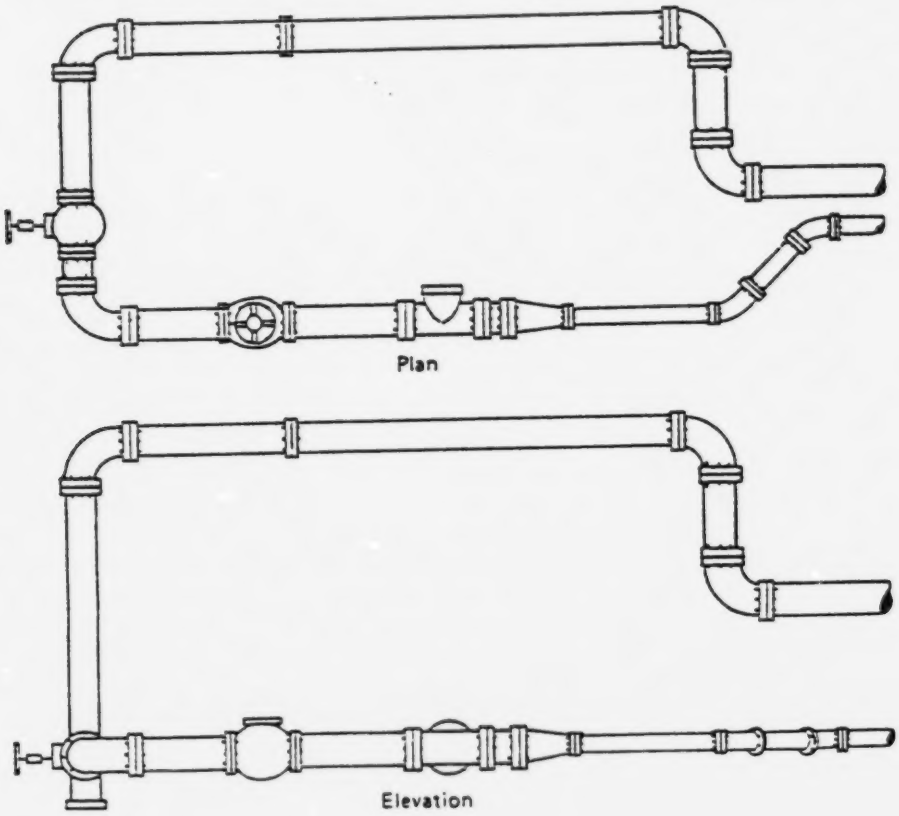


Figure 10-1 Double Line Drawings

Or, you might with to examine only the plan view. You would focus on the following features:

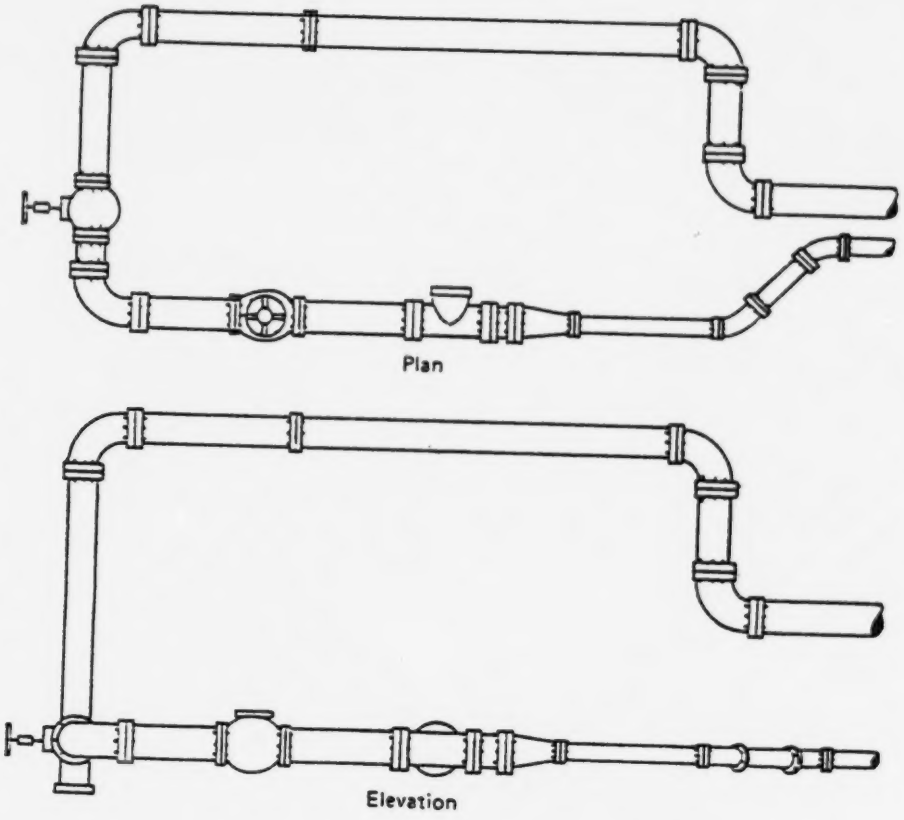


Figure 10-1 Double Line Drawings

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Perhaps you want to examine the location of couplings in the plan. You might focus on the following details:

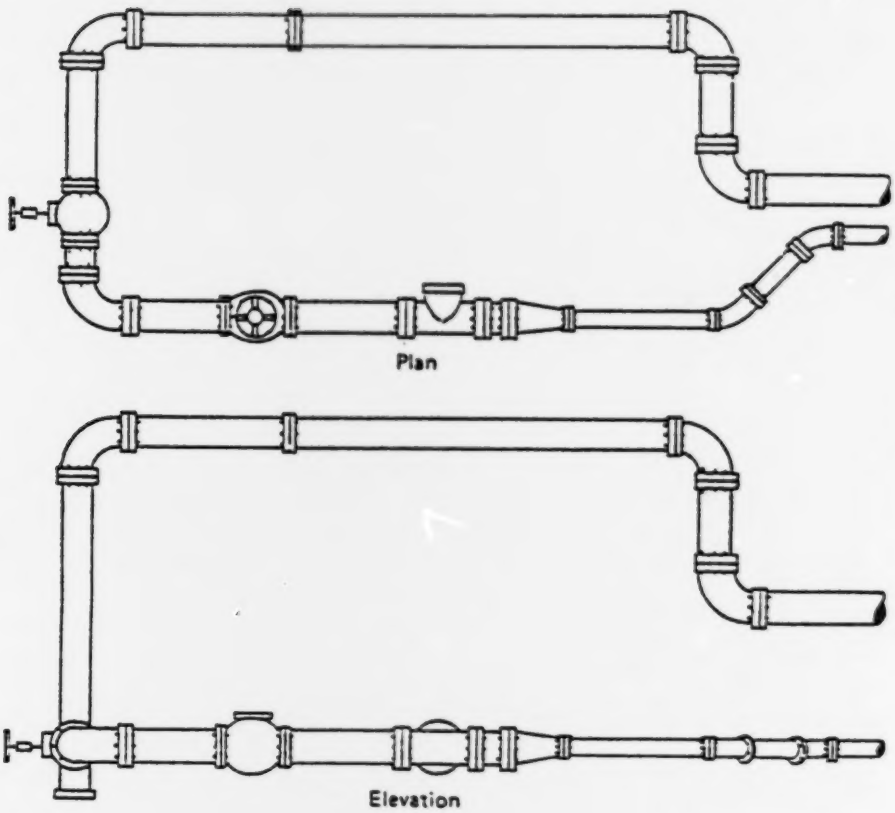


Figure 10-1 Double Line Drawings

# 1 Exercise

The supervisor saw some workers strip threads when tightening bolts. He knew they were familiar with beam torque wrenches. He decided they just had problems with micrometer setting torque wrenches. He gave them the following:

## THE MICROMETER SETTING TORQUE WRENCH

**The micrometer setting torque wrench is commonly called the click or the breakaway torque wrench. When the proper torque is reached the wrench makes a click and the handle releases, or "breaks," and moves freely for a short distance, This makes sure that the proper torque has been applied.**

**To adjust the micrometer setting for torquing, you must understand the scale used on the handle. Sample micrometer markings are shown in Figure 10-26.**

**The barrel of the handle contains marks and numbers. Each number stands for 100 inch-pounds or 100 foot-pounds, depending on the torque wrench. Each mark between the numbers measures 25 inch- or foot-pounds.**

**The sleeve also contains marks and numbers. Each of these marks is numbered. All of these numbers and marks must be added to find the torque setting. Look at Figure 10-26. Starting at the left of the index line, go the right and find the number two. Then count the marks between the two and the sleeve (3 marks). Each mark equals 25 inch-pounds.**

10

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In Figure 10-26 the barrel shows 275 inch-pounds. But, the sleeve is not even with the third mark. The sleeve mark (10) is in line with the index line, so 10 inch-pounds must be added to the 275 inch-pounds shown on the barrel. The total setting is 285 inch-pounds.

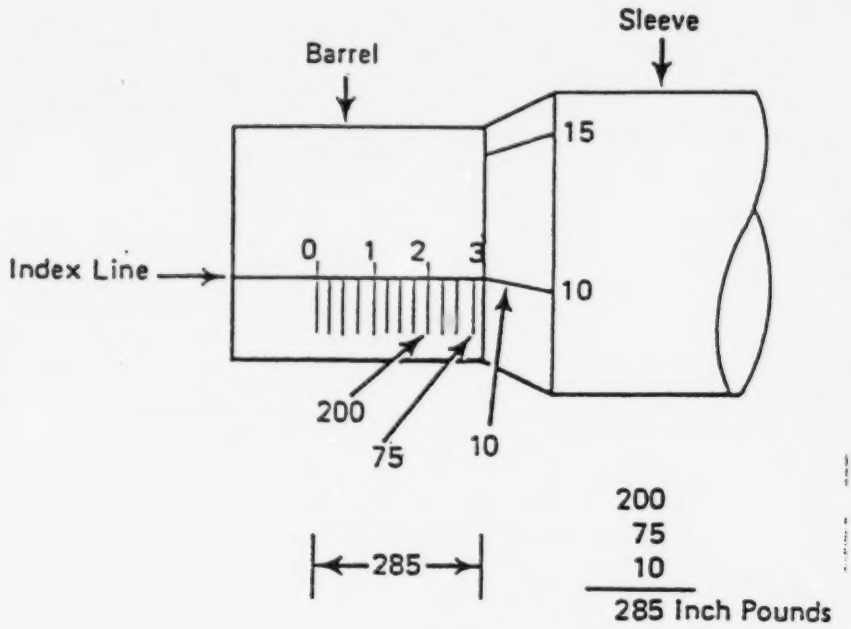


Figure 10-26 Micrometer Torque Markings

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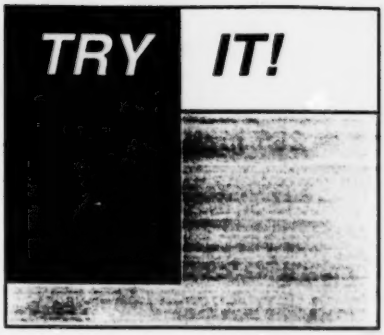


1. Where is the title?

_____

2. What is the title?

_____

3. What labels are given?

_____

4. What seems to be the purpose of the diagram?

_____

5. Does text accompany the diagram? _____ What is the relationship between the text and the diagram?

_____

_____

6. Where might you find the item shown in the diagram?

_____

_____

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11

**1. The supervisor asked Fred to get a breakaway torque wrench. What should Fred get?**

**A. a beam torque wrench**
**B. a dial torque wrench**
**C. a click wrench**
**D. none of the above**

(a) Is the answer to this question found on the diagram?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

**2. What could each number on the barrel represent?**

**A. 100 inch-pounds**
**B. 25 foot pounds**
**C. 1 inch**
**D. 15 pounds of pressure**

(a) Is the answer to this question found on the diagram?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

**3. Keith sets a wrench for 50 foot-pounds of torque. How many barrel marks show 50 foot pounds?**

**A. 1**
**B. 2**
**C. 3**
**4. 4**

(a) Is the answer to this question found on the diagram?

_____

_____

(b) How did you know?

_____

_____

14

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(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

**4. Clark needs to apply 125 inch-pounds of torque. What should be the micrometer wrench setting?**

**A. barrel number 1, 2 marks, 0 sleeve setting**
**B. barrel number 2, 1 mark, 10 sleeve setting**
**C. barrel number 1, 1 mark, 0 sleeve setting**
**D. barrel marking 2, 2 marks, 15 sleeve setting**

(a) Is the answer to this question found on the diagram?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

**5. Coy inserted a bolt with 340 inch-pounds of torque. He stripped the threads. He checked his micrometer torque wrench. It was set at the following: barrel number 3, 2nd mark, sleeve number 15. What's wrong?**

**A. The bolt was of poor quality.**
**B. The barrel number should be on 2.**
**C. Coy should have set it on the first mark.**
**D. The sleeve number should be 10.**

(a) Is the answer to this question found on the diagram?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

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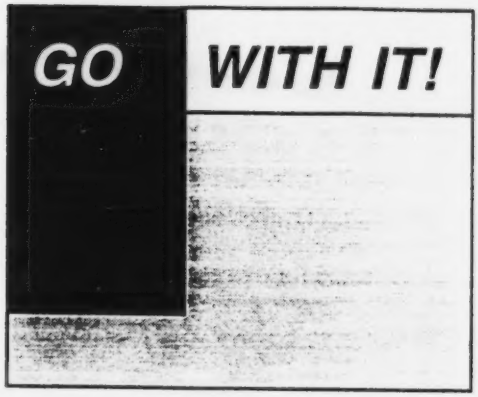


A new worker has joined your crew. You have the diagram, but not the accompanying text. Describe the process in adjusting the micrometer setting for torquing at 285 inch pounds.

# 2 Exercise

J & J Construction Company's safety record was poor. The last accident occurred during flame cutting. The manager wants all workers to review information about using gas cylinders in flame cutting. He gives them the following:

## GAS CYLINDERS

**Oxygen and acetylene cylinders are built to rigid specifications. The oxygen cylinder must be drawn in one piece from high carbon steel, no part of which is less than one-quarter inch thick. Before going into service it is tested at 3360 psi (pounds per square inch), but must be able to retain twice that pressure. Once in service it must be tested every ten years. Stamped onto the shoulder of each oxygen cylinder is the date when it was put into service as well as the history of its testing. The cutaway view of an oxygen cylinder in Figure 1 shows the typical dimensions of a common cylinder.**

**The construction of the acetylene cylinder is more complex due to the nature of the gas itself. The cylinder shell is made from pieces of deep drawn steel which are welded together. A forged steel valve "spud" is then welded in place at the top of the cylinder. It is the inside of the cylinder, however, which makes it quite unlike an oxygen cylinder.**

**Acetylene is unstable at pressures over 15 psi, therefore, it would be unsafe to fill a hollow cylinder with acetylene to a pressure near 250 psi. In order to make acetylene cylinder must be specially constructed.**

**The inside of an acetylene cylinder is first packed with a moist filler which is rigid but porous (See figure 3). The cylinder is then baked in an oven for several days until a weight check indicates that all the moisture has been baked out. Federal regulations require that the filler cure to a porosity of 85%. Finally, the cylinder valve and fuse plugs are installed.**

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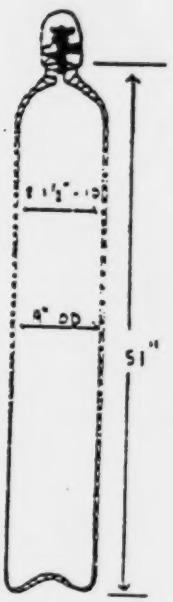



Figure 1. Cutaway of cylinder

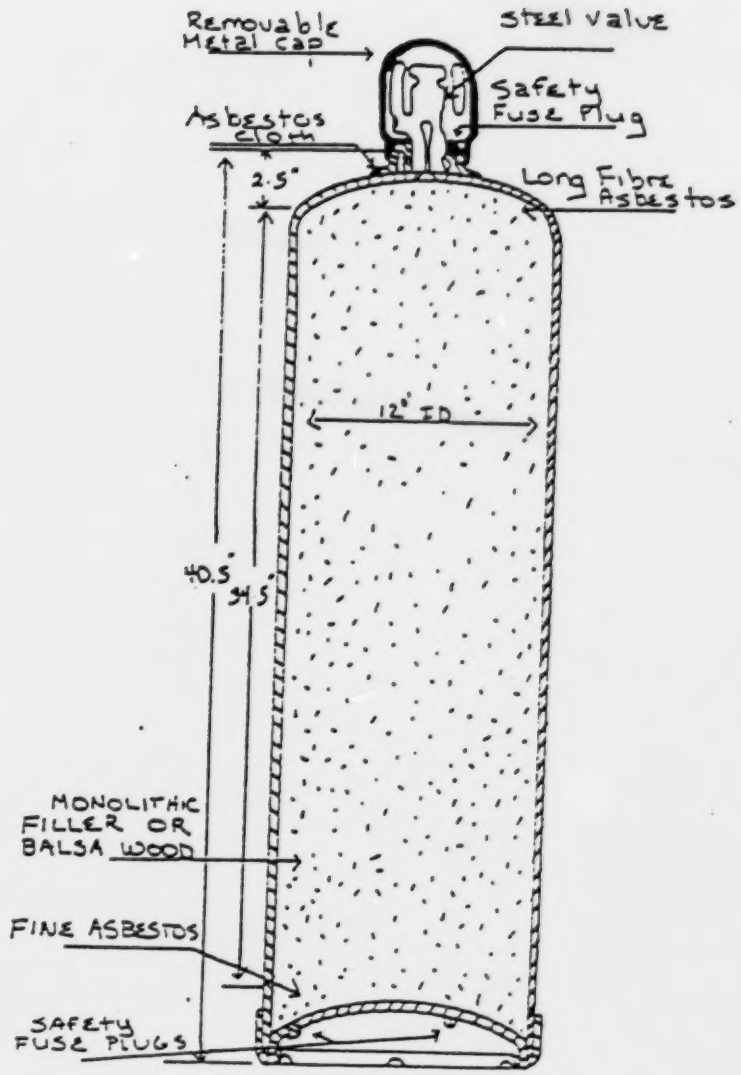
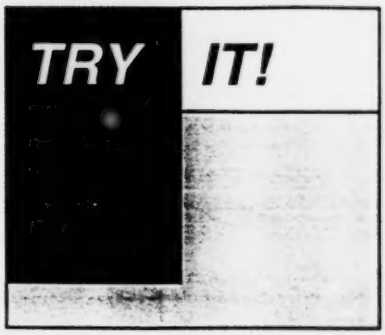



Figure 3. Cutaway view




1. Where are the titles?

_____

2. What are the titles?

_____

3. What labels are given?

_____

_____

_____

4. Why are there two diagrams?

_____

5. What seems to be their purposes?

_____

5. Does text accompany the diagrams? _____ What is the relationship between the text and the diagrams?

_____

_____

6. Where might you find the item shown in the diagram?

_____

_____

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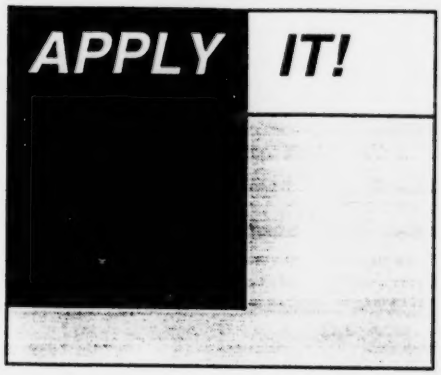


**1. Sam checks cylinders. He finds one which has been welded from deep-drawn steel. What does the cylinder most likely contain?**

**A. Oxygen**
**B. Acetylene**
**C. Either Oxygen or Acetylene**
**D. Neither Oxygen or Acetylene**

(a) Is the answer to this question found on the diagrams?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

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**2. Nate reads about acetylene cylinders. He looks at the diagrams. He thinks the moist filler inside the cylinder is probably**

**A. acetone**
**B. balsa wood**
**C. brass**
**D. He cannot tell from the diagram.**

(a) Is the answer to this question found on the diagrams?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

**3. Nancy knows asbestos resists fire. She looks at the diagram for acetylene cylinders. She finds it contains three kinds of asbestos. What are the three kinds?**

**1)**
_____

**2)**
_____

**3)**
_____

(a) Is the answer to this question found on the diagrams?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

**4. How many safety fuse plugs are found in an acetylene cylinder?**

**A. 1**
**B. 2**
**C. 3**
**D. 4**

(a) Is the answer to this question found on the diagrams?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

**5. Examine the diagram. What appears to be the inside diameter of the acetylene cylinder?**

**A. 40.5 inches**
**B. 34.5 inches**
**C. 12 inches**
**D. You cannot tell from the diagram.**

(a) Is the answer to this question found on the diagrams?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

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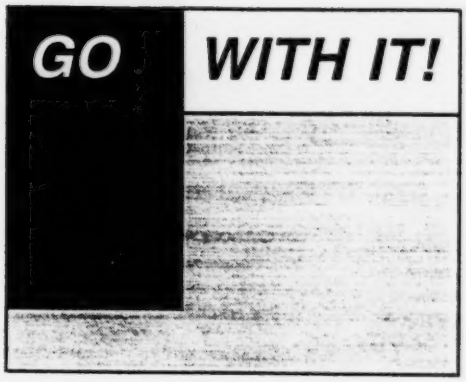



Diagrams show relationships. The relationships can be within one diagram. They can also between two related diagrams. Identify three relationships between the two diagrams.

# 3 Exercise

Bob's plant is upgrading production capacities. They are modifying the current piping system. This includes installation of some valves. Bob reads the following:

### Valve Terminology

Certain terms are used in the discussion of valves that must be understood by pipefitters who will be involved with the installation and removal of valves. The most important of these terms are:

1. "Trim" designates the parts of a valve that receive the most wear and are, consequently, replaceable. Trim includes the stem, disc, seat ring, disc holder or guide, wedge, and bushings.
2. "Straight-through flow" is a self-explanatory terms that describes a flow that is not restricted. The element that closes the valve is re tracted entirely clear of the passage.
3. "Full flow" is a term used to designate the relative flow capacities of various valves.
4. "Throttled flow" describes the condition in which the valve is nearly closed. A valve capable of throttling provides a control of the rate of flow through the valve. Not all types of valves are suitable for throttled flow.

### Materials and Applications

Valves are made from practically every machineable material. The most common types of materials from which valves are made are iron, carbon steel, bronze, aluminum, alloy steels, and polyvinyl chloride (PVC). Circumstances dictate which material to use in a particular application. There is generally more than one "correct" material that will satisfy the requirements of a given situation.

Bronze or iron with bronze trim is used in valves used in air and water service. Iron is also used for valves used for low pressure steam applications.

Steel is used for valves that regulate non-corrosive products. Ductile (modular) iron, on the other hand, is less expensive than steel and offers better resistance to mechanical or thermal shock than steel.

Stainless steel, although expensive is required for valves that are to be used for regulate the flow of corrosive services. Stainless steel is also used for those applications in which it is necessary to prevent the contamination
of fluids flowing through a line. Most valves used in "cryogenic" very low temperature) applications are made from stainless steel because stainless steel does not get as brittle as iron or carbon steel at low temperatures.

Difficult chemicals require specialized valve bodies. These are made from plastic, rubber, ceramics or special alloys.

26 25

## GATE VALVES

A gate valve is a valve in which the flow is controlled by moving a "gate" or disc that slides in machined grooves at right angles to the flow. The gate is moved by the action of the threaded stem on the control handle.

Gate valves are the most widely used of all valves. They provide less obstruction to flow, and less turbulence within the valve itself. Seating is at right angles to the line or fluid, so there is less resistance to flow.

Gate valves should not be used for throttling operations. They are best when used in conditions where operation is infrequent and the valve will be either fully opened or closed. Close control of flow is practically impossible.

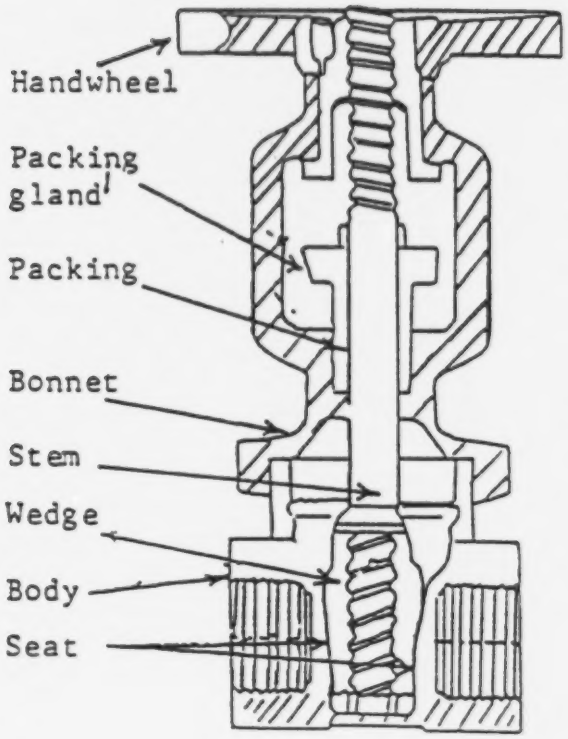
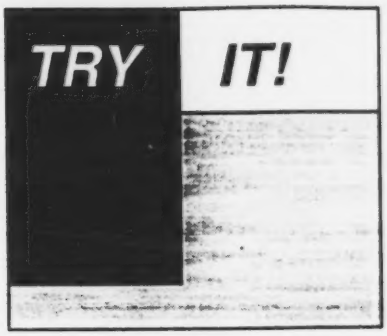



Figure 1. Gate Valve




1. Where is the title?

_____

2. What is the title?

_____

3. What labels are given?

_____

_____

_____

5. What seems to be the purpose of the diagram?

_____

6. Does text accompany the diagram? _____ What is the relationship between the text and the diagram?

_____

_____

7. Where might you find the item shown in the diagram?

_____

_____

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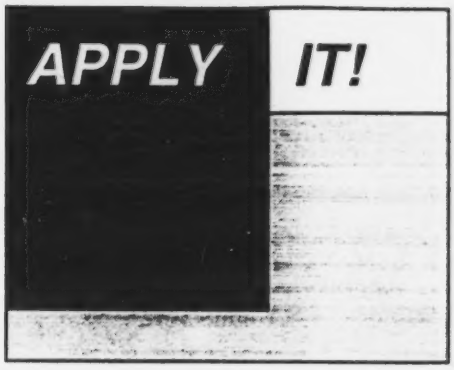



**1. Bob is installing a gate valve. It will be on a line that carries corrosive materials. What material would be best for the construction of this valve?**

**A. ductile iron**
**B. PVC**
**C. stainless steel**
**D. bronze**

(a) Is the answer to this question found on the diagrams?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

**2. Which of the following valve parts is most likely to come in contact with the materials carried in the piping system?**

**A. Seat**
**B. Bonnet**
**C. Handwheel**
**D. none of the above**

(a) Is the answer to this question found on the diagrams?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

**3. Bob shows the new gate valve to a new operator. What is the correct term for the control handle?**

**A. stem**
**B. packing**
**C. seat**
**D. handwheel**

(a) Is the answer to this question found on the diagrams?

_____

_____

(b) How did you know?

_____

_____

30

29

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

**4. You overhear Bob describing gate valve functioning to the operator. You realize that one of the statements he made is incorrect. Which one is it?**

**A. Gate valves provide less obstruction to flow.**
**B. Gate valves cause less turbulence within the valve.**
**C. Gate valves are best used to throttle the flow.**
**D. Close control of flow in a gate valve is practically impossible.**

(a) Is the answer to this question found on the diagrams?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

**5. Bob checks some of the older gate valves. He finds some have trim which need replacement. Referring to the diagram, which part is trim?**

**A. handwheel**
**B. stem**
**C. body**
**D. bonnet**

(a) Is the answer to this question found on the diagrams?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

**6. Bob must install a gate valve. It will be on a vertical pipe. At what angle should the pipe be installed?**

**A. 90 degrees to the pipe.**
**B. 180 degrees to the pipe**
**C. 360 degrees to the pipe**
**D. 45 degrees to the pipe**

(a) Is the answer to this question found on the diagrams?

_____

_____

(b) How did you know?

32

_____

_____

31

(c) How did you find the answer?

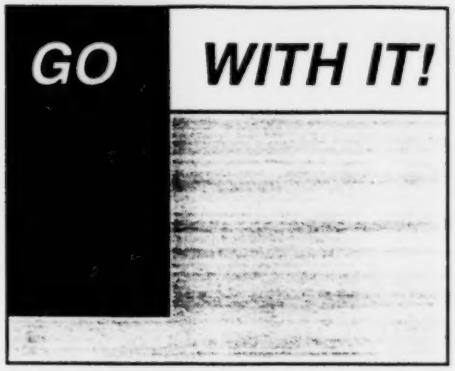
_____

_____

(d) Identify the information you used to answer the question.

_____

_____




Examine the diagram. Answer each of the following questions in complete sentences.

- What happens if you loosen the handwheel?

- What seems to be the function of the packing gland?

- Which parts are on the outside of the gate valve?

34

33

# 4 Exercise

Craig and Kay work together. They work on an underground pipeline. You are the project supervisor. You refer to the following information when questions arise.

## TRENCH BOXES

**A trench box is a large steel box that provides a safe means of shoring by allowing workers to lay pipe within it. The box is places into the cut and moved by the hydraulic excavator as the cut progresses.**

**For deeper cuts, trench boxes can be stacked on top of each other, or sides can be added for more protection.**

**Since most trench boxes are assembled at the jobsite, it si possible to add different spreaders to vary the width of the box. The rule of thumb for trench box width is to use a trench box 12" wider than the width of the bucket on the hydraulic excavator.**

**In stable soils, the hydraulic excavator can cut the trench ahead of the trench box to its required width and depth and then pull the box ahead to allow the workers to lay the next section of pipe.**

**In unstable soil, the hydraulic excavator can dig inside the box and tamp the box down to subgrade. After the workers install the pipe, the hydraulic excavator pulls the box forward and continues digging inside for the next section of pipe.**

**Trench boxes are handled with a special bridle. Four cables, each with a hook on the end, are attached to a steel ring. The ring is attached to a hook welded to the bucket of the hydraulic excavator.**

35
34

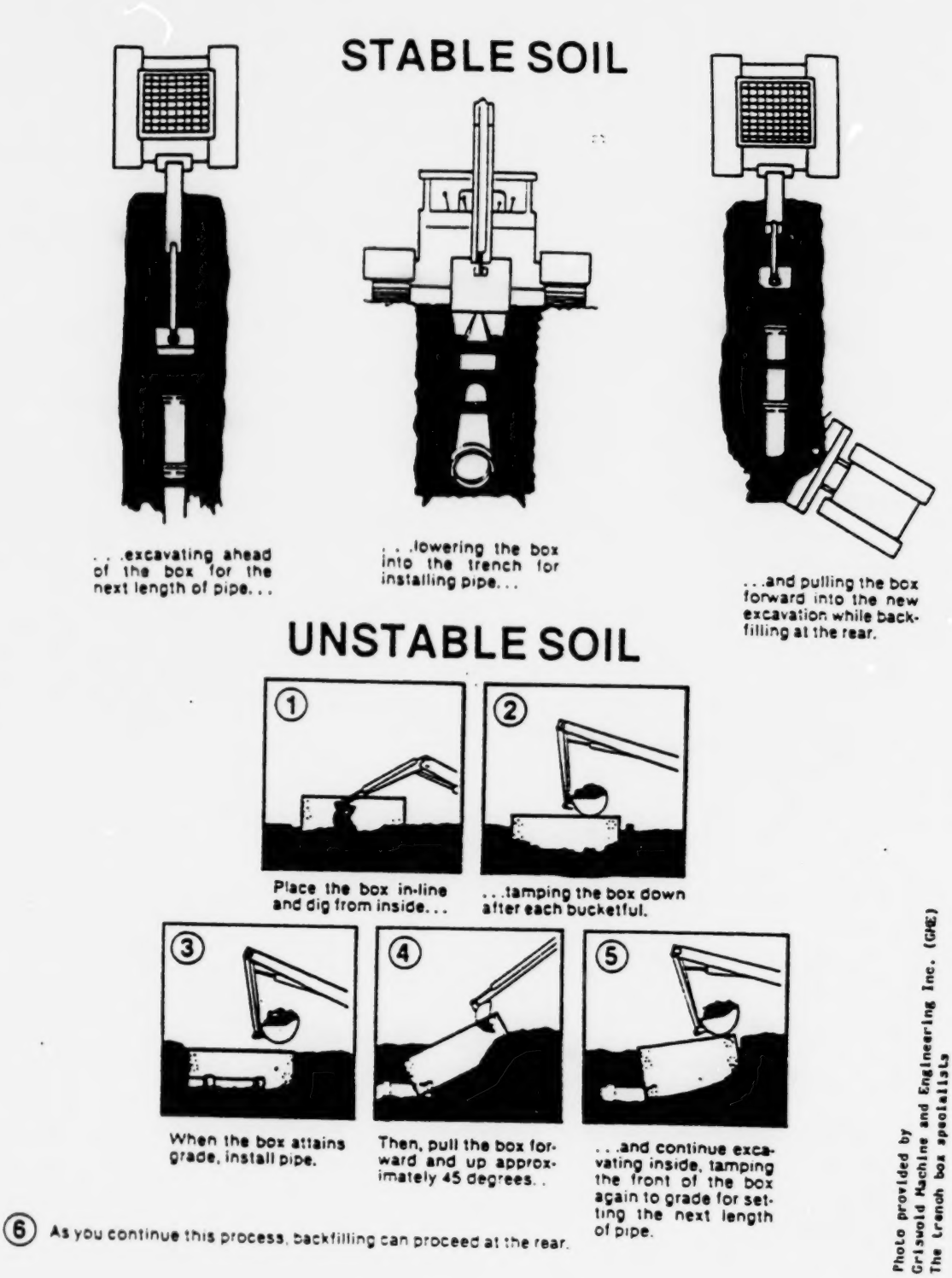

STABLE SOIL
. . .excavating ahead of the box for the next length of pipe. . .
. . .lowering the box into the trench for installing pipe. . .
. . .and pulling the box forward into the new excavation while backfilling at the rear.
UNSTABLE SOIL
1
2
Place the box in-line and dig from inside. . .
. . .tamping the box down after each bucketful.
3
4
5
When the box attains grade, install pipe.
Then, pull the box forward and up approximately 45 degrees. .
. . .and continue excavating inside, tamping the front of the box again to grade for setting the next length of pipe.
6 As you continue this process, backfilling can proceed at the rear.
Photo provided by
Griswold Machine and Engineering Inc. (GME)
The trench box specialists

Figure 6. Using a trench box



BEST COPY AVAILABLE

1. Where is the title?

_____

2. What is the title?

_____

3. This diagram actually contrasts two soil conditions. What are those two conditions?

_____

4. Which soil condition requires the most work? How do you know?

_____

_____

5. What seems to be the purpose of the diagram?

_____

6. Does text accompany the diagram? _____ What is the relationship between the text and the diagram?

_____

_____

7. Where might you use the processes shown in the diagram?

_____

_____

**1. Craig says they've hit unstable soil. He wants to shore up the soil. He asks you how to use a trench box. The first thing you say is**

**A. "Put the box in and excavate ahead of the box."**
**B. "Place the trench box in line and dig on the outside."**
**C. "Place the trench box in-line and dig on the inside."**
**D. "Backfill at the rear and pull the box in line."**

(a) Is the answer to this question found on the diagrams?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

**2. Kay says the crew must move a trench box in unstable soil. She wants to pull the box forward. She asks you what angle she should use. You recommend**

**A. 180 degrees**
**B. 360 degrees**
**C. 90 degrees**
**D. 45 degrees**

(a) Is the answer to this question found on the diagrams?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

**3. Craig reports that they are in stable soil. What should they do first?**

**A. Excavate ahead of the box.**
**B. Lower the box into the trench.**
**C. Backfill at the rear.**
**D. You cannot tell from the diagram.**

(a) Is the answer to this question found on the diagrams?

_____

_____

(b) How did you know?

_____

_____ 39 38

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

**4. The hydraulic excavator is being used to cut a trench. It's bucket is 36 inches wide. What should be the width of the trench box?**

**A. 36 inches**
**B. 40 inches**
**C. 48 inches**
**D. You cannot tell from this information.**

(a) Is the answer to this question found on the diagrams?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

The diagrams differ in **perspective.** This means the viewpoint of the artist. Compare the perspectives for stable and unstable soils.

# 5 Exercise

Jeri knows how to use a torque wrench to tighten bolt holes in flanges. Today she must install flange joints. Since she is unfamiliar with this, she reviews the following:

## TORQUING SEQUENCE

**To properly torque a flange joint, you must use a cross-over method of tightening the bolts. Torque the top bolt first, then the bolt directly opposite. Then torque the side bolt and the bolt directly opposite it. This method puts even pressure on the flange and prevents warping. The figure below shows this method. Follow the letters from A to H for the proper torquing order.**

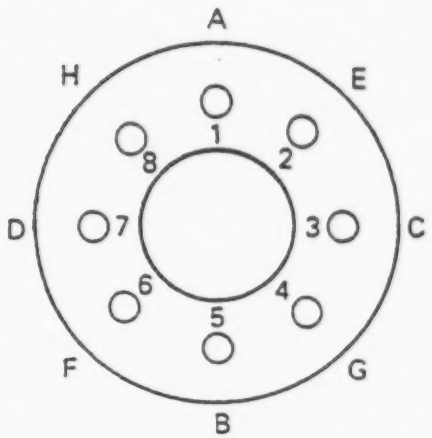



Figure 10-33. Torquing Sequence

1. Where is the title?

_____

2. What is the title?

_____

3. What labels are used on this diagram?

_____

4. For what do the letters stand? the numbers?

_____

_____

5. What seems to be the purpose of the diagram?

_____

6. Does text accompany the diagram? _____ What is the relationship between the text and the diagram?

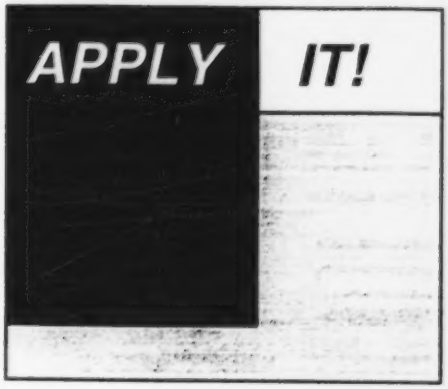
_____

_____

7. Where might you use the process shown in the diagram?

_____

_____




**1. Refer to the diagram. What bolt should Jeri tighten first?**

**A. #1**
**B. #8**
**C. #2**
**D. #5**

(a) Is the answer to this question found on the diagram?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

**2. Refer to the diagram. What bolt should Jeri tighten last?**

**A. #1**
**B. #8**
**C. #2**
**D. #5**

(a) Is the answer to this question found on the diagram?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

**3. In what order should Jeri tighten the bolts?**

**A. 1,5,3,7,2,6,4,8**
**B. 1,2,3,4,5,6,7,8**
**C. 1,4,5,8,2,3,6,7**
**D. 8,7,6,5,4,3,2,1**

(a) Is the answer to this question found on the diagram?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

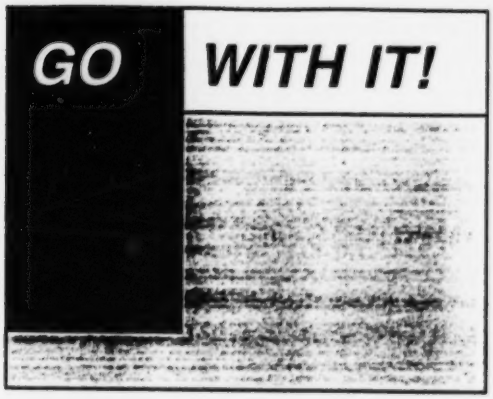
_____

_____

(d) Identify the information you used to answer the question.

_____

_____




Redraw the diagram. Use arrows to indicate the order in which bolts should be tightened.

47

46

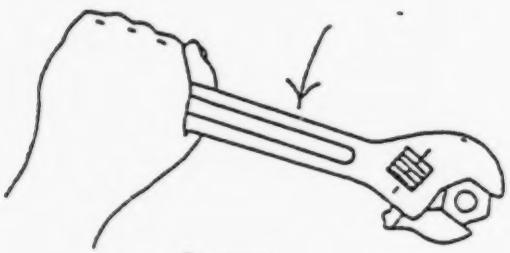
# 6 Exercise

Anne is paying bills. She finds a page from her ABC manual mixed with them. She looks at the diagram, but is not sure what it shows. She reads the accompanying material.

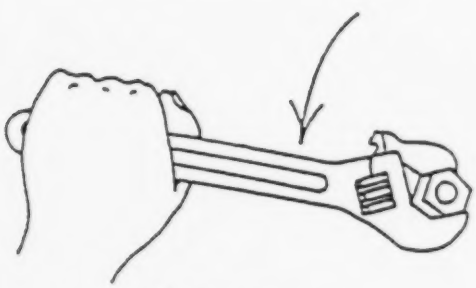
**These points must be remembered concerning adjustable wrenches.**

1. **Keep adjustable wrenches clean. Do not allow mud or grease to clog the adjusting screw and slide. Oil these parts frequently.**
2. **To use and adjustable wrench properly, place the wrench on the fastener and tighten the jaws for a snug fit. Fail to do this will round off the edges of the fastener.**
3. **Make sure the pulling force is applied to the stationary jaw of the adjustable wrench. This side of the wrench is stronger.**

**The two most common sizes of adjustable wrenches a pipefitter should carry are 10" and 12".**



Correct



Incorrect

48 47

1. Is there a title? Where is the title?

_____

2. What labels are used on this diagram?

_____

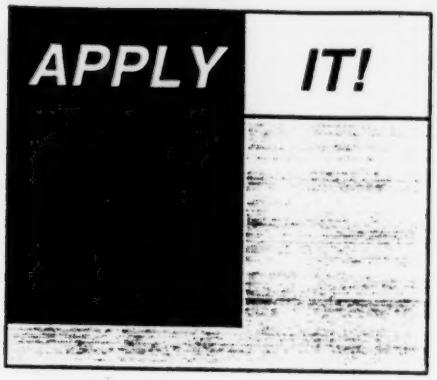
3. What seems to be the purpose of the diagram?

_____

4. Does text accompany the diagram? _____ What is the relationship between the text and the diagram?

_____

_____




**1. What part of the text tells Anne the main idea of the diagram?**

**A. Point #1**
**B. Point #2**
**C. Point #3**
**D. You cannot tell the main idea from the text.**

(a) Is the answer to this question found on the diagram?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

**2. What would be a good title for this diagram?**

_____

(a) Is the answer to this question found on the diagram?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

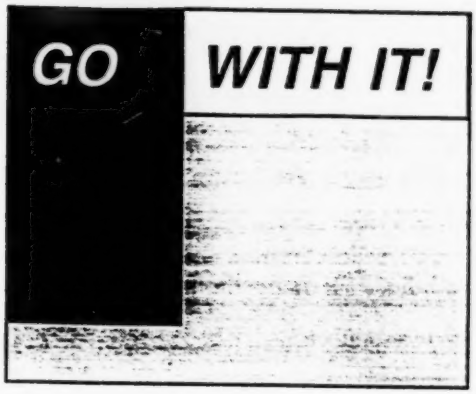
_____

_____

(d) Identify the information you used to answer the question.

_____

_____




Describe how the correct and incorrect usage of a wrench differ.

52

51

# 7 Exercise

Kwan is learning how to use welding processes to join carbon steel pipe. He knows he must understand the terms connected with that. He reads the following:

### Terminology

**The following terms should be part of every experienced pipefitter's vocabulary:**

1. **The land, or root face, provides an additional thickness of metal at the root of the weld. The purpose of the land is to reduce the possibility of burnthrough during the welding process.**

2. **The gap, or root opening, is the separation between the mating pipe and/or fittings at the joint. It allows the welding electrode access to the joint to insure a full penetration weld. Proper gap is crucial to a good fit-up. If the gap is too small, proper fusion is difficult to obtain. If the gap is too large, burnthrough may result.**

3. **The bevel angle is the angle cut on the edge of the pipe or fitting. For most applications the bevel angle will be between 30 and 37.5 degrees. However, thick pipe walls sometimes require compound bevels.**

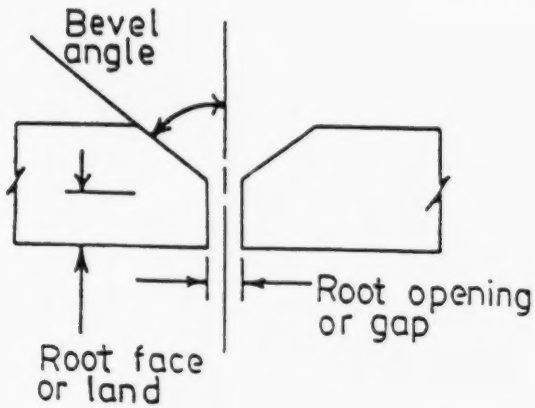
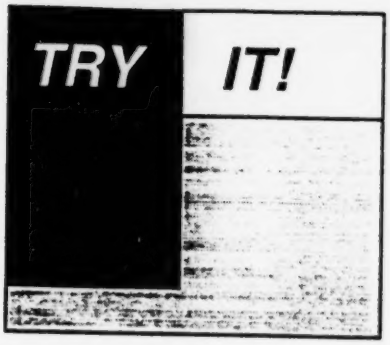



Figure 2. The pipe joint




1. Where is the title?

_____

2. What is the title?

_____

3. What labels are used on this diagram?

_____

4. What do the arrows show?

_____

_____

5. What does bevel mean?

_____

6. What seems to be the purpose of the diagram?

_____

7. Does text accompany the diagram? _____ What is the relationship between the text and the diagram?

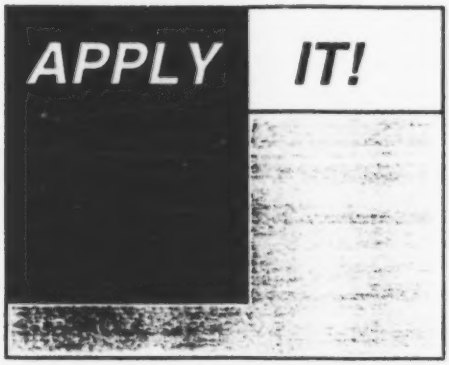
_____

_____

8. Where might you use the process shown in the diagram?

_____

_____




**1. Kwan bevels a pipe. He uses a 90 degree angle. What is probably true?**

**A. The angle is too large.**
**B. The angle is too small.**
**C. The angle is correct.**
**D. You cannot tell from the given information.**

a) Is the answer to this question found on the diagram?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

**2. What is the same as a land?**

**A. a gap**
**B. a root opening**
**C. a bevel angle**
**D. a root face**

a) Is the answer to this question found on the diagram?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

**3. The figure shows 2 pipes or fittings. The one on the left shows a root face. Is there a root face on the right?**

**A. No**
**B. Yes, it is on the bottom.**
**C. Yes it is on the top.**
**D. You cannot tell from the diagram.**

a) Is the answer to this question found on the diagram?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

**4. Kwan welded a pipe and a fitting. There was burnthrough. What happened?**

**A. Root gap was too small.**
**B. Root face was too thick.**
**C. Root gap was too large.**
**D. You cannot tell from this information.**

(a) Is the answer to this question found on the diagram?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

57

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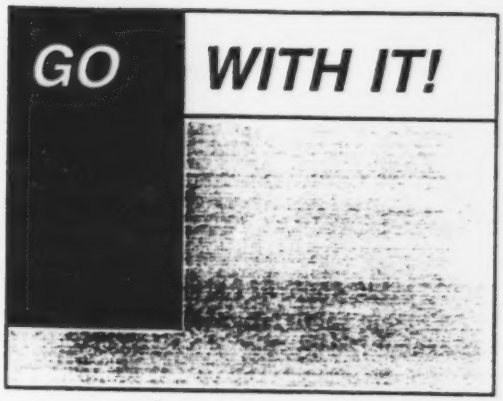



The description says that "The following terms should be part of every experienced pipefitter's vocabulary." Why are these terms important?

58

57

# 8 Exercise

One of the workers on Abdul's crew retired. He left some of his tools to Abdul. Abdul knows how to use most of them. But, he got some files that he did not know how use. He find the following information about files:

**Files come in a variety of shapes and sizes. They may be either single or double cut. They are classified according to coarseness or fineness. This classification is based on the size and spacing of the teeth.**

**A file consists of several parts (See Figure 1). The part of the file which contains the teeth is called the face. The other end of the file is tapered. This part fits into a handle. It is called the tang. The part of the file where the tang starts is called the heel. The length of the file is the distance from the top to the heel. Length does not include the tang.**

**A file's teeth are set at an angle across the face of the file. A file with a single row of parallel teeth is called a single-cut file. The teeth are cut at an angle of 65 to 85 degrees. A criss-crossed file is called a double-cut file. Its surface has a very large number of teeth which are slanted toward the tip of the file.**

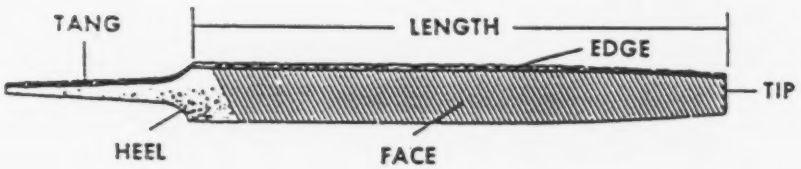
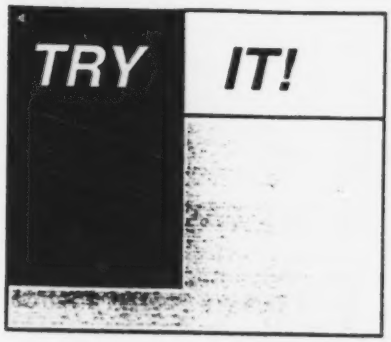



Figure 1




1. Is there a title? If not, what would be a good title?

_____

2. What labels are used on this diagram?

_____

3. What seems to be the purpose of the diagram?

_____

4. Does text accompany the diagram? _____ What is the relationship between the text and the diagram?

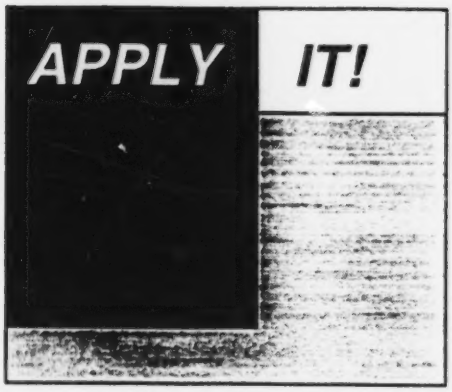
_____

_____

5. How might you use the tool shown in the diagram?

_____

_____




**1. Abdul measures the files. One is twelve inches from tip to heel. It is two inches from heel to the end of the tang. What is the size of the file?**

**A. a 14 inch file**
**B. a 12 inch file**
**C. a 10 inch file**
**D. none of the above**

(a) Is the answer to this question found on the diagram?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

61

60

**2. Where would Abdul find the teeth of a file?**

**A. on the tang**
**B. on the heel**
**C. on the face**
**D. none of the above**

(a) Is the answer to this question found on the diagram?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

**3. What kind of file is shown in figure 1?**

**A. double-cut file**
**B. single-cut file**
**C. You cannot tell from the diagram.**

(a) Is the answer to this question found on the diagram?

_____

_____

(b) How did you know?

_____

_____

62 61

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

63

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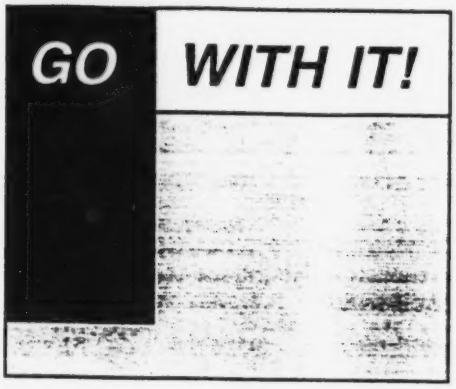


Diagrams are visual descriptions. Write 3 sentences which describe the diagram.

*EXAMPLE: A file's handle is called the tang.*

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# 9 Exercise

Tim looks at the isometric drawing of the project piping system. He sees he must thread pipe. He has not had to thread pipe recently. He decided to review threading in his ABC manual. He read the following:

65

64

## PIPE THREADING MACHINES

A pipe threading machine is an electrically powered machine that centers and chucks pipe, conduit or bolt stock and rotates it while cutting, threading or reaming operations are performed. The machine will rotate either clockwise or counterclockwise. Pipe threading machines are available that will handle pipe from 1/8 inch nominal size to 4 inches in nominal size.

Figure 8 illustrates the basic parts of a typical pipe threading machine. These are:

1. Chuck. This centers and holds the pipe.
2. Rear centering device. This rotates with the chuck.
3. "Cutter." The cutter is self-centering.
4. "Reamer." The reamer is used to remove the burr caused by the cutting operation. Re moval of this burr restores the pipe to its original inside diameter.
5. Foot switch. This is used to supply power to the machine as it is needed. A foot switch frees the operator's hands for other duties.
6. Selector switch. This three position switch has stops for FORWARD, OFF, and REVERSE.
7. Oil spout. During the threading operation, oil is fed to the dies.
8. "Dies." These do the actual cutting. Dies are interchangeable and vary according to the type of thread being cut. There are special dies that cut the tapered pipe thread and special stainless steel dies that must be used when threading stainless steel pipe. Dies are also available for threading bolts.
9. Chip pan. This is the pan that collects the various shavings from the operations performed by the machine.

1. Where is the title?

_____

2. What is the title?

_____

3. What labels are used on this diagram?

_____

4. What seems to be the purpose of the diagram?

_____

5. Does text accompany the diagram? _____ What is the relationship between the text and the diagram?

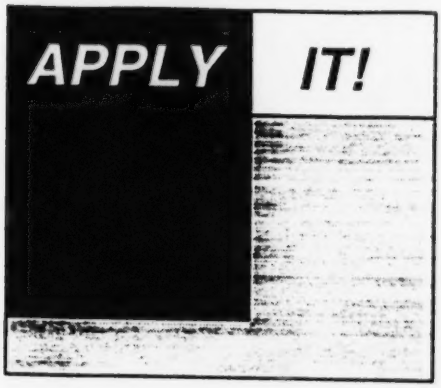
_____

_____

6. Where might you use the machine shown in the diagram?

_____

_____




1. Tim is confused. Some parts on the diagram were not described in the text. Identify two parts which were not shown on the diagram.

1. _____

2. _____

(a) How did you find the answer?

_____

_____

(b) Identify the information you used to answer the question.

_____

_____

2. What two kinds of handwheels would Tim find on a pipe threading machine?

1. _____

2. _____

(a) Is the answer to this question found on the diagram?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

(d) Identify the information you used to answer the question.

**3. What does a reamer look like? Why do you think it looks this way?**

(a) Is the answer to this question found on the diagram?

(b) How did you know?

(c) How did you find the answer?

(d) Identify the information you used to answer the question.



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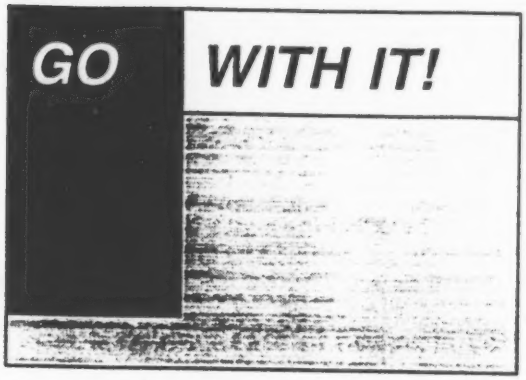


Identify 3 facts from reading and looking at the information about pipe threading machines.

***EXAMPLE: Pipe threading machines can cut, thread, or ream pipe.***

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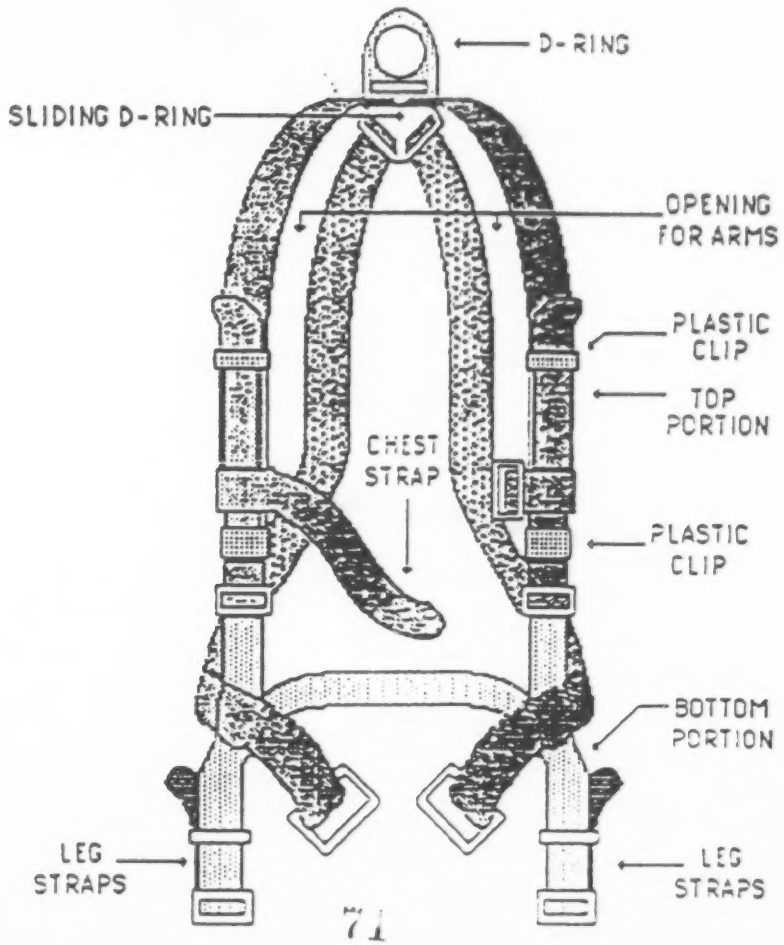
# 10 Exercise

Trina is installing pipe in a cooling tower. She works in an area which is more than six feet off the ground. She must wear a fall restraint device. She got full body harness. She also got the following information about its use:

**Fall restraint devices are used in areas which do not have guardrails. Employees working on aerial lifts, portable ladders, of at distances greater than six feet from the ground must wear them. A full body harness is generally better than a safety belt. A full body harness distributes the shock load over the shoulders, thighs and seat area. This reduces the chance of injury. It is comfortable to wear. It does not limit mobility. The harness should be connected so that a fall is limited to a maximum of four feet. A lanyard is used to connect the harness to an anchorage point.**

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FULL BODY HARNESS 70

1. Where is the title?

_____

2. What is the title?

_____

3. What labels are used on this diagram?

_____

4. What do the arrows show?

_____

_____

5. What seems to be the purpose of the diagram?

_____

6. Does text accompany the diagram? _____ What is the relationship between the text and the diagram?

_____

_____

7. Where might you use the equipment shown in the diagram?

_____

_____

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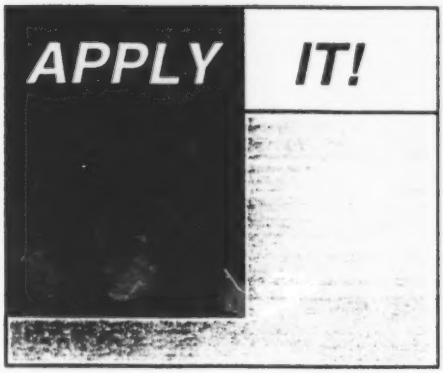



**1. Trina tried to figure out how to use a full body harness. She found that the last person who wore it was much taller than she is. What part does she adjust to shorten the harness?**

**A. the plastic clip on the top portion**
**B. the chest strap**
**C. the D ring**
**D. All of the above parts would be adjusted.**

(a) Is the answer to this question found on the diagram?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

2. How many straps will cross Trina's chest?

A. 1
B. 2
C. 3
D. 4

(a) Is the answer to this question found on the diagram?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

_____

_____

(d) Identify the information you used to answer the question.

_____

_____

3. Trina wants to secure herself to an anchorage point. What part of the harness might she use to attach the lanyard?

A. the leg straps
B. the openings for arms
C. the chest strap
D. the D-ring

(a) Is the answer to this question found on the diagram?

_____

_____

(b) How did you know?

_____

_____

(c) How did you find the answer?

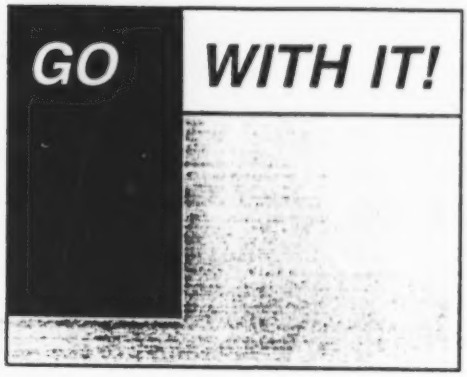
_____

_____

(d) Identify the information you used to answer the question.

_____

_____




Your co-worker doesn't want to wear a full body harness. She says it's too uncomfortable. Describe three features which are designed to make the full body harness adjustable and comfortable.

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